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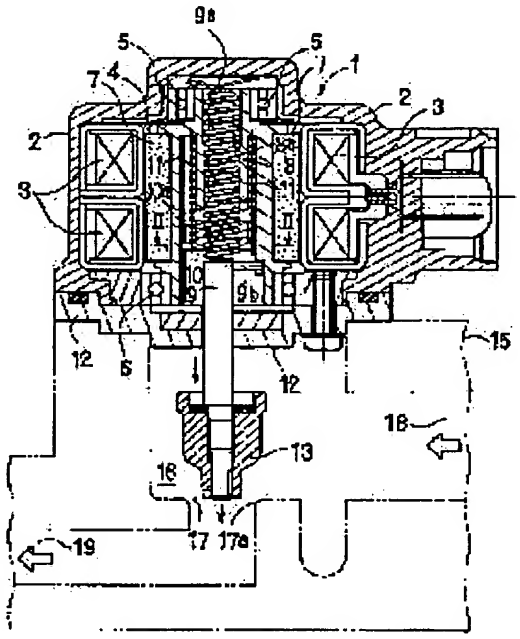
(54) STEPPING MOTOR

(57)Abstract:
PURPOSE: To provide a stepping motor, which can decrease the friction and abrasion of a screw part and can alleviate a rotating load.
CONSTITUTION: This stepping motor 1 has the structure, wherein the rotation of a rotor 4 is converted into the movement in the axial direction by the action of a screw, and an output shaft 9 is moved into the axial direction. The motor is formed in the tubular shape, and a plurality of permanent magnets 7 are provided at the outer surface part. At the same time, the following parts are provided. A screw supporting part 8 having a tapped hole at the shaft-center position is provided in a rotor 4. The output shaft 9 has a male screw at the outer surface part. The output shaft 9 is screwed and inserted into the tapped hole of the screw supporting part 8 of the rotor 4. A spring bearing member 10 is arranged in the rotor 4 so that the member 10 can be moved in the axial direction and has a tapped hole at the shaft center position. The output shaft 9 is screwed and inserted into the tapped hole. A compression spring 11 is arranged between the rotor 4 and the spring bearing member 10 and energizes the rotor 4 and the spring bearing member 10 into the relative axial direction.



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CLAIMS

[Claim(s)]
[Claim 1] While changing rotation of Rota into a motion of shaft orientations according to an operation of a screw thread, being formed in tubed in the step motor made to move an output shaft to shaft orientations and preparing two or more permanent magnets in the periphery section Rota in which the **** supporter which ****s in an axis location and has a hole was formed, and the output shaft which has a male screw in the periphery section, and is screwed and inserted in the screw-thread hole of the screw-thread supporter of this Rota, The spring bearing member which is arranged by shaft orientations movable in this Rota, ****s in an axis location and has a hole and by which this output shaft is screwed and inserted in this **** hole, The step motor characterized by having a spring means to be arranged between this Rota and this spring bearing member, and to energize this Rota and this spring bearing member to relative shaft orientations.
[Claim 2] The step motor according to claim 1 said whose spring means is a compression coil spring.
[Claim 3] The step motor according to claim 1 said whose spring means is a spring washer.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a step motor applicable to the flow control valve used for an internal combustion engine's inhalation-of-air system, an exhaust air system, etc.
[0002]
[Description of the Prior Art] The valve chest which has two or more ports in valve housing as a flow control valve used for an internal combustion engine's inhalation-of-air system, an exhaust air system, etc. is formed, the valve element and the valve seat section of a lift type are prepared in the valve chest, and the flow control valve of the structure where the motor to which the valve stem of a valve element is moved was attached in valve housing is known (for example, refer to JP,4-108367,U).
[0003] Generally a step motor is used for this kind of flow control valve, it is inserted so that the output shaft which a female screw is formed in the inner circumference of Rota which has a building envelope in an axis location, and has a male screw may be acceptable in that Rota and that step motor may screw with ****, and a valve element is attached at the tip of an output shaft through direct or a valve stem. And through the thread part between Rota and an output shaft, rotation of Rota is changed into a motion of shaft orientations, an output shaft, i.e., a valve element, is moved to shaft orientations, and a valve is opened and closed.
[0004]
[Problem(s) to be Solved by the Invention] By the way, although this kind used with an internal combustion engine of flow control valve receives a remarkable vibration at the time of operation of an engine, in order that it may control vibration of the output shaft attached through **** and may prevent backlash peculiar to actuation of ****, in the former, the compression coil spring which energizes an output shaft (valve element) to an one direction is formed between a valve element and housing or between an output shaft and housing.
[0005] This compression coil spring 30 is formed for example, between the housing 33 which supports the upper part of a valve element 31, and the output shaft 32 on it (valve stem), as shown in drawing 5 . Where an output shaft 32 is pulled back most up, when a valve serves as a close by-pass bulb completely where an output shaft 32 is projected most caudad, and a valve is opened fully, a valve in the location of a close by-pass bulb completely Since [that the height of a compression coil spring 30 is high] the compressibility is small, the spring load concerning an output shaft 32 is small, but since a compression coil spring 30 is compressed in the state of full open of a valve, the spring load increases.
[0006] For this reason, the spring constant of the compression coil spring 30 attached for the purpose of control of vibration of an output shaft 32 or prevention of backlash is in the close-by-pass-bulb-completely condition of a valve, i.e., the condition that compressibility is small and that a spring load is small, and since it is set up so that it may have spring force sufficient in order to prevent vibration etc., the spring load of the coiled spring which changed into the compression condition at the time of full open of a valve becom s fairly large.
[0007] Therefor , the rotation load increased and the step motor had th problem which causes increase of the torque of a step motor, and large-siz d-ization of a configuration, when a valve element was moved in the open direction (above). Moreover, when the energization force of a compression coil spring 30 became large, there was a problem on which the frictional force of the thread part 35 of Rota

34 and an output shaft 32 increases, and wear of the part increases.
[0008] This invention was made in view of the above-mentioned point, reduces friction and wear of a thread part, and aims at offering the step motor which can aim at mitigation of a rotation load.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the step motor of this invention While changing rotation of Rota into a motion of shaft orientations according to an operation of a screw thread, being formed in tubed in the step motor made to move an output shaft to shaft orientations and preparing two or more permanent magnets in the periphery section Rota in which the **** supporter which ****s in an axis location and has a hole was formed, and the output shaft which has a male screw in the periphery section, and is screwed and inserted in the screw-thread hole of the screw-thread supporter of Rota, It is arranged by shaft orientations movable in Rota, it ****s in an axis location, has a hole, and is arranged between the spring bearing member by which an output shaft is screwed and inserted in the screw-thread hole, and Rota and a spring bearing member, and it has a spring means to energize Rota and a spring bearing member to relative shaft orientations, and is constituted.
[0010] Here, as a spring means, a compression coil spring or a spring washer can be used.
[0011]
[Function and Effect] In the step motor of such a configuration, when Rota rotates on the left by the starting, according to an operation of the screw-thread supporter of Rota and the thread part of an output shaft, rotation of Rota is changed into a motion of the shaft orientations of an output shaft, and it moves so that an output shaft may project the tip. On the other hand, according to an operation of the screw-thread supporter of Rota and the thread part of an output shaft, when Rota rotates on the right, it moves so that an output shaft may pull back the tip.
[0012] In the meantime, since the spring means arranged between Rota and a spring bearing member is always energizing Rota and a spring bearing member to relative shaft orientations, in the thread part which an output shaft, the screw-thread supporter of Rota, and an output shaft and a spring bearing member screw, the screw thread side which is always one side contacts, and the backlash of **** is prevented.
[0013] For this reason, when used for the intense flow control valve of vibration of a step motor, vibration of an output shaft can be controlled to the minimum, and generating of the backlash of a thread part can also be prevented.
[0014] Furthermore, since what is necessary is just to set the spring load of a spring means as the minimum value which can prevent vibration of an output shaft and the backlash of a thread part, it can make frictional force of a thread part fewer than before, and can reduce wear of a thread part.
[0015] Furthermore, the spring load of the spring means arranged between Rota and a spring bearing member is always fixed at the minimum value, and since it does not operate like before so that an output shaft may compress a compression coil spring, a motor can be miniaturized from reduction of the torque which mitigates sharply and needs the load of an output shaft.
[0016]
[Example] Hereafter, the example of this invention is explained based on a drawing.
[0017] Drawing 1 shows the sectional view of the flow control valve which applied the step motor of this invention. 2 is housing of a step motor 1, in housing 2, the stator which looped the bobbin around the exiting coil 3 is fixed, and Rota 4 is arranged in the inside. Rota 4 is supported free [rotation] through ball bearings 5 and 6 to housing 2 in the upper part and lower part.
[0018] The whole is formed in tubed and, as for Rota 4, two or more permanent magnets 7 are fixed to the periphery section. Furthermore, male screw 9a of the below-mentioned output shaft 9 screws in female screw 8a which the **** supporter 8 which ****s in the center in the axis location of Rota 4, and has a hole was formed, and was formed in the inner circumference.
[0019] Furthermore, as shown in the enlarged drawing of drawing 3 , the spring bearing member 10 is arranged in the location which counters the **** supporter 8 inside the axis location of Rota 4. The spring bearing member 10 has the **** hole which had female screw 10a in the center, and an output shaft 9 makes female screw 10a and male screw 9a screw in the screw-thread hole, and is inserted in it. Moreover, the spring bearing member 10 is pivotable with Rota 4, permitting migration of shaft orientations by having a height and a flat part and making the height and flat part engage with the

crevice where it corresponded in Rota 4, as shown in drawing 2 .
[0020] It ****s with the spring bearing member 10 arranged in Rota 4, and a compression coil spring 11 is arranged between supporters 8. The spring load can be set as arbitration by ****ing with the spring bearing member 10 and adjusting spacing of a supporter 8 by energizing a compression coil spring 11 to the repulsion shaft orientations which isolate the screw-thread supporter 8 and the spring bearing member 10 of Rota 4 which the output shaft 9 screwed.
[0021] And when a flow control valve is actually used and the spring load of a compression coil spring 11 receives vibration, it is set as vibration of the output shaft 9 by the backlash of a thread part, friction of a thread part and wear, and extent that can control the backlash of a thread part effectively by the minimum value.
[0022] The lower part of an output shaft 9 penetrates caudad a projection and the covering plate 12 fixed to the lower part of housing 2 out of Rota 4, and a valve element 13 is fixed at the tip. The lower part of an output shaft 9 is supported by shaft orientations movable while it is formed so that it may have a variant cross section, and the part prevents rotation by bearing of the covering plate 12. Moreover, stopper 9b for projecting with the pull back edge to some output shafts 9, and stopping at the end is prepared.
[0023] As shown in drawing 1 R> 1, the step motor 1 of such a configuration is fixed downward to the upper part of the valve housing 15 so that the valve element 13 at the tip of an output shaft may be inserted into the valve chest 16.
[0024] It is the structure where the circulation hole 17 which prepared valve seat 17a in the perimeter is formed in the valve chest 16 bottom, and the circulation hole 17 is opened and closed by a rise and descent of a valve element 13. The inlet-port port 18 is established in the right-hand side of the valve chest 16, and an exit port 19 is established in the left-hand side of the valve housing 15.
[0025] Next, if actuation of a flow control valve is explained, when closing the valve, a step motor 1 rotates Rota 4 leftward. If Rota 4 rotates leftward, according to an operation of the screw-thread supporter 8 of Rota 4 and the thread part of an output shaft 9, rotation of Rota 4 will be changed into a motion of the shaft orientations of an output shaft 9, and it will move so that an output shaft 9 may project the tip.
[0026] On the other hand, when opening a valve, a step motor 1 rotates Rota 4 rightward. If Rota 4 rotates rightward, it will move according to an operation of the screw-thread supporter 8 of Rota 4 and the thread part of an output shaft 9 so that an output shaft 9 may pull back the tip.
[0027] In the meantime, since the compression coil spring 11 arranged between the screw-thread supporter 8 of Rota 4 and the spring bearing member 10 is always energizing Rota 4 and the spring bearing member 10 to relative shaft orientations, in the thread part which an output shaft 9, the screw-thread supporter 8 of Rota 4, and an output shaft 9 and the spring bearing member 10 screw, the screw thread side which is always one side contacts, and the backlash of **** is prevented.
[0028] For this reason, when used for the intense flow control valve of vibration of a step motor 1, vibration of an output shaft 9 can be controlled to the minimum, and generating of the backlash of a thread part can also be prevented.
[0029] Furthermore, since what is necessary is just to set the spring load of a compression coil spring 11 as the minimum value which can prevent vibration of an output shaft 9 and the backlash of a thread part, it can make frictional force of a thread part fewer than before, and can reduce wear of a thread part.
[0030] Furthermore, the spring load of the compression coil spring 11 arranged between Rota 4 and the spring bearing member 10 is always fixed at the minimum value irrespective of migration of an output shaft 9, and like before, since it does not operate so that an output shaft may compress a compression coil spring, it can mitigate the load of an output shaft 9 sharply. Therefore, since the torque of the motor to need can be reduced, it becomes possible to miniaturize a motor.
[0031] Drawing 4 shows other examples. In this example, instead of the above-mentioned compression coil spring 11, the spring washers 21, such as a wav washer, **** with the spring bearing member 20, and it is arranged betw en support rs 28, and ****s with the spring bearing member 20 with this spring washer 21, and a supporter 28 is energized by relative shaft orientations. Although it operates like the above and its operation and effectiveness are also the same as when this spring washer 21 is used, when a spring washer 21 is used, the die length of the shaft orientations of Rota 4 can be made shorter

than the case where a compression coil spring is used.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing of longitudinal section of the flow control valve which used the step motor of this invention.
[Drawing 2] It is the II-II sectional view of drawing 1 .
[Drawing 3] It is an expanded sectional view inside a rotor.
[Drawing 4] It is an expanded sectional view inside the rotor of other examples.
[Drawing 5] It is drawing of longitudinal section of the flow control valve which used the conventional step motor.
[Description of Notations]
1-step motor, 4-Rota, 7-permanent magnet, 9-output shaft, 10-spring bearing member, 11-compression coil spring.

[Translation done.]

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審査請求　未請求　請求項の数３　ＯＬ　（全５頁）

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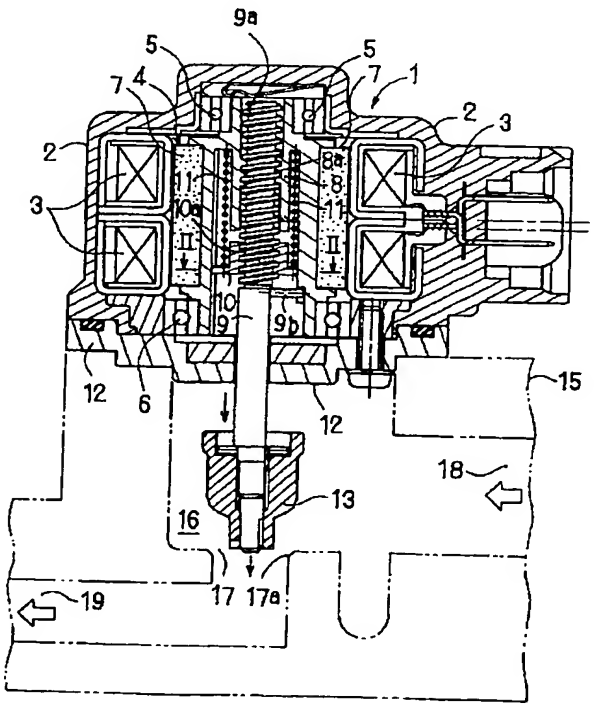
(54)【発明の名称】　ステップモータ

(57)【要約】
【目的】ねじ部の摩擦や摩耗を低減させ、回転負荷の軽減を図ることができるステップモータを提供する。
【構成】このステップモータ１は、ねじの作用によりロータ４の回転を軸方向の動きに変換し、出力軸９を軸方向に移動させる構造であり、筒状に形成され、外周部に複数の永久磁石７を設けると共に、軸芯位置にねじ孔を有するねじ支持部８を設けたロータ４と、外周部におねじを有し、ロータ４のねじ支持部８のねじ孔に螺合して挿入される出力軸９と、ロータ４内に軸方向に移動可能に配設され、軸芯位置にねじ孔を有し、そのねじ孔に出力軸９が螺合して挿入されるばね受部材１０と、ロータ４とばね受部材１０との間に配設され、ロータ４とばね受部材１０を相対軸方向に付勢する圧縮コイルばね１１と、を備える。



【特許請求の範囲】
【請求項１】　ねじの作用によりロータの回転を軸方向の動きに変換し、出力軸を軸方向に移動させるステップモータにおいて、
筒状に形成され、外周部に複数の永久磁石を設けると共に、軸芯位置にねじ孔を有するねじ支持部を設けたロータと、
外周部におねじを有し、該ロータのねじ支持部のねじ孔に螺合して挿入される出力軸と、
該ロータ内に軸方向に移動可能に配設され、軸芯位置にねじ孔を有し、該ねじ孔に該出力軸が螺合して挿入されるばね受部材と、
該ロータと該ばね受部材との間に配設され、該ロータと該ばね受部材を相対軸方向に付勢するばね手段と、
を備えたことを特徴とするステップモータ。
【請求項２】　前記ばね手段が圧縮コイルばねである請求項１記載のステップモータ。
【請求項３】　前記ばね手段がばね座金である請求項１記載のステップモータ。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、内燃機関の吸気系、排気系等に使用される流量制御弁に適用可能なステップモータに関する。
【０００２】
【従来の技術】内燃機関の吸気系、排気系等に使用される流量制御弁として、弁ハウジング内に複数のポートを持つ弁室が形成され、弁室内にリフト式の弁体と弁座部が設けられ、弁体の弁軸を移動させるモータが弁ハウジングに取付けられた構造の流量制御弁が知られている（例えば、実開平４－１０８３６７号公報参照）。
【０００３】この種の流量制御弁には、一般にステップモータが使用され、そのステップモータは、軸芯位置に内部空間を有するロータの内周に、めねじが設けられ、おねじを有する出力軸がそのロータ内のめねじと螺合するように挿入され、出力軸の先端に弁体が直接或は弁軸を介して取付けられる。そして、ロータと出力軸間のねじ部を介して、ロータの回転を軸方向の動きに変換し、出力軸つまり弁体を軸方向に移動させ、弁の開閉を行う。
【０００４】
【発明が解決しようとする課題】ところで、内燃機関で使用されるこの種の流量制御弁は、機関の運転時にかなりの振動を受けるが、ねじを介して取付けられる出力軸の振動を抑制し、ねじの動作に特有のバックラッシュを防止するために、従来では、弁体とハウジング間、或は出力軸とハウジング間に、出力軸（弁体）を一方向に付勢する圧縮コイルばねが設けられている。
【０００５】この圧縮コイルばね３０が、例えば、図５に示すように、弁体３１の上部とその上の出力軸（弁軸）３２を支持するハウジング３３間に設けられ、出力軸３２が下方に最も突き出された状態で弁が全閉となり、出力軸３２が上方に最も引き戻された状態で弁が全開となる場合、弁が全閉の位置では、圧縮コイルばね３０の高さは高くその圧縮率は小さいため、出力軸３２にかかるばね荷重は小さいが、弁が全開の状態では、圧縮コイルばね３０が圧縮されるため、そのばね荷重が増大する。
【０００６】このため、出力軸３２の振動の抑制やバックラッシュの防止を目的として取付けられる圧縮コイルばね３０のばね定数は、弁の全閉状態、つまり圧縮率が小さくばね荷重が小さい状態で、振動等を防止するために充分なばね力を有するように設定されるため、弁の全開時に圧縮状態となったコイルばねのばね荷重は相当大きくなる。
【０００７】したがって、ステップモータは、弁体を開方向（上側）に移動させる場合、その回転負荷が増大し、ステップモータのトルクの増大や形状の大形化を招く問題があった。また、圧縮コイルばね３０の付勢力が大きくなると、ロータ３４と出力軸３２のねじ部３５の摩擦力が増大し、その部分の摩耗が増大する問題があった。
【０００８】本発明は、上記の点に鑑みてなされたもので、ねじ部の摩擦や摩耗を低減させ、回転負荷の軽減を図ることができるステップモータを提供することを目的とする。
【０００９】
【課題を解決するための手段】上記目的を達成するために、本発明のステップモータは、ねじの作用によりロータの回転を軸方向の動きに変換し、出力軸を軸方向に移動させるステップモータにおいて、筒状に形成され、外周部に複数の永久磁石を設けると共に、軸芯位置にねじ孔を有するねじ支持部を設けたロータと、外周部におねじを有し、ロータのねじ支持部のねじ孔に螺合して挿入される出力軸と、ロータ内に軸方向に移動可能に配設され、軸芯位置にねじ孔を有し、そのねじ孔に出力軸が螺合して挿入されるばね受部材と、ロータとばね受部材との間に配設され、ロータとばね受部材を相対軸方向に付勢するばね手段と、を備えて構成される。
【００１０】ここで、ばね手段としては、圧縮コイルばね或はばね座金を使用することができる。
【００１１】
【作用・効果】このような構成のステップモータでは、その起動によりロータが例えば左に回転したとき、ロータのねじ支持部と出力軸のねじ部の作用によって、ロータの回転が出力軸の軸方向の動きに変換され、出力軸がその先端を突出すように移動する。一方、ロータが右に回転したとき、ロータのねじ支持部と出力軸のねじ部の作用によって、出力軸がその先端を引き戻すように移動する。

【００１２】この間、ロータとばね受部材との間に配設されたばね手段は、常時、ロータとばね受部材を相対軸方向に付勢しているため、出力軸とロータのねじ支持部及び出力軸とばね受部材の螺合するねじ部では、常に一方のねじ山面が接触してねじのガタツキが防止される。

【００１３】このため、ステップモータが振動の激しい流量制御弁に使用された場合、出力軸の振動を最小限に抑制することができ、ねじ部のバックラッシュの発生も防止することができる。

【００１４】さらに、ばね手段のばね荷重は、出力軸の振動とねじ部のバックラッシュを防止し得る最小の値に設定しておけばよいため、ねじ部の摩擦力を従来より少なくし、ねじ部の摩耗を低減することができる。

【００１５】さらに、ロータとばね受部材との間に配設されたばね手段のばね荷重は、常に最小値で一定であり、従来のように、出力軸が圧縮コイルばねを圧縮するように動作することがないため、出力軸の負荷を大幅に軽減し、必要とするトルクの低減からモータを小型化することができる。

【００１６】

【実施例】以下、本発明の実施例を図面に基づいて説明する。

【００１７】図１は、本発明のステップモータを適用した流量制御弁の断面図を示している。２はステップモータ１のハウジングであり、ハウジング２内には、ボビンに励磁コイル３を巻装したステータが固定され、その内側にロータ４が配設される。ロータ４はハウジング２に対し、その上部と下部を玉軸受５、６を介して回転自在に支持される。

【００１８】ロータ４は全体が筒状に形成され、外周部に複数の永久磁石７が固定される。さらに、ロータ４の軸芯位置には中央にねじ孔を有するねじ支持部８が形成され、その内周に形成されためねじ８ａに、後述の出力軸９のおねじ９ａが螺合する。

【００１９】さらに、図３の拡大図に示すように、ロータ４の軸芯位置の内部には、ねじ支持部８に対向する位置にばね受部材１０が配設される。ばね受部材１０は中央にめねじ１０ａを持ったねじ孔を有し、そのねじ孔に出力軸９が、めねじ１０ａとおねじ９ａを螺合させて挿入される。また、ばね受部材１０は、図２に示すように、突起部と平坦部を有し、その突起部と平坦部をロータ４内の対応した凹部に係合させることにより、軸方向の移動を許容しながら、ロータ４と共に回転可能である。

【００２０】ロータ４内に配置されたばね受部材１０とねじ支持部８との間に、圧縮コイルばね１１が配設される。圧縮コイルばね１１は、出力軸９が螺合したロータ４のねじ支持部８とばね受部材１０とを離隔する相反軸方向に付勢し、そのばね荷重は、ばね受部材１０とねじ支持部８の間隔を調整することにより、任意に設定することができる。

【００２１】そして、圧縮コイルばね１１のばね荷重は、流量制御弁が実際に使用されて振動を受けた際、ねじ部のガタツキによる出力軸９の振動、ねじ部の摩擦や摩耗、ねじ部のバックラッシュを効果的に抑制することができる程度に最小値に設定される。

【００２２】出力軸９の下部はロータ４内から下方に突出し、ハウジング２の下部に固定したカバー板１２を貫通し、その先端に弁体１３が固定される。出力軸９の下部は異形断面を持つように形成され、その部分がカバー板１２の軸受部によって回転を阻止すると共に、軸方向に移動可能に支持される。また、出力軸９の一部にはその引き戻し端と突出端で停止するためのストッパ９ｂが設けられる。

【００２３】このような構成のステップモータ１は、図１に示すように、その出力軸先端の弁体１３を弁室１６内に挿入するように、弁ハウジング１５の上部に下向きに固定される。

【００２４】弁室１６の下側には、周囲に弁座１７ａを設けた流通孔１７が形成され、弁体１３の上昇・下降により流通孔１７が開閉される構造である。弁室１６の右側には入口ポート１８が設けられ、弁ハウジング１５の左側には出口ポート１９が設けられる。

【００２５】次に、流量制御弁の動作を説明すると、その弁を閉じる場合、ステップモータ１はロータ４を左方向に回転させる。ロータ４が左方向に回転すると、ロータ４のねじ支持部８と出力軸９のねじ部の作用によって、ロータ４の回転が出力軸９の軸方向の動きに変換され、出力軸９がその先端を突き出すように移動する。

【００２６】一方、弁を開く場合、ステップモータ１はロータ４を右方向に回転させる。ロータ４が右方向に回転すると、ロータ４のねじ支持部８と出力軸９のねじ部の作用によって、出力軸９がその先端を引き戻すように移動する。

【００２７】この間、ロータ４のねじ支持部８とばね受部材１０との間に配設された圧縮コイルばね１１は、常時、ロータ４とばね受部材１０を相対軸方向に付勢しているため、出力軸９とロータ４のねじ支持部８及び出力軸９とばね受部材１０の螺合するねじ部では、常に一方のねじ山面が接触し、ねじのガタツキが防止される。

【００２８】このため、ステップモータ１が振動の激しい流量制御弁に使用された場合、出力軸９の振動を最小限に抑制することができ、ねじ部のバックラッシュの発生も防止することができる。

【００２９】さらに、圧縮コイルばね１１のばね荷重は、出力軸９の振動とねじ部のバックラッシュを防止し得る最小値に設定しておけばよいため、ねじ部の摩擦力を従来より少なくし、ねじ部の摩耗を低減することができる。

【００３０】さらに、ロータ４とばね受部材１０との間

に配設された圧縮コイルばね１１のばね荷重は、出力軸９の移動に拘らず常に最小値で一定であり、従来のように、出力軸が圧縮コイルばねを圧縮するように動作することがないため、出力軸９の負荷を大幅に軽減することができる。したがって、必要とするモータのトルクを低減できるため、モータを小型化することが可能となる。

【００３１】図４は他の実施例を示している。この例では、上記圧縮コイルばね１１の代りに、ウエーブワッシャ等のばね座金２１がばね受部材２０とねじ支持部２８との間に配設され、このばね座金２１によりばね受部材２０とねじ支持部２８が相対軸方向に付勢される。このばね座金２１を使用した場合も、上記と同様に動作し、その作用・効果は同様であるが、ばね座金２１を使用した場合、圧縮コイルばねを使用する場合より、ロータ４の軸方向の長さを短くすることができる。

【図面の簡単な説明】

【図１】本発明のステップモータを使用した流量制御弁の縦断面図である。

【図２】図１のII－II断面図である。

【図３】ロータ内部の拡大断面図である。

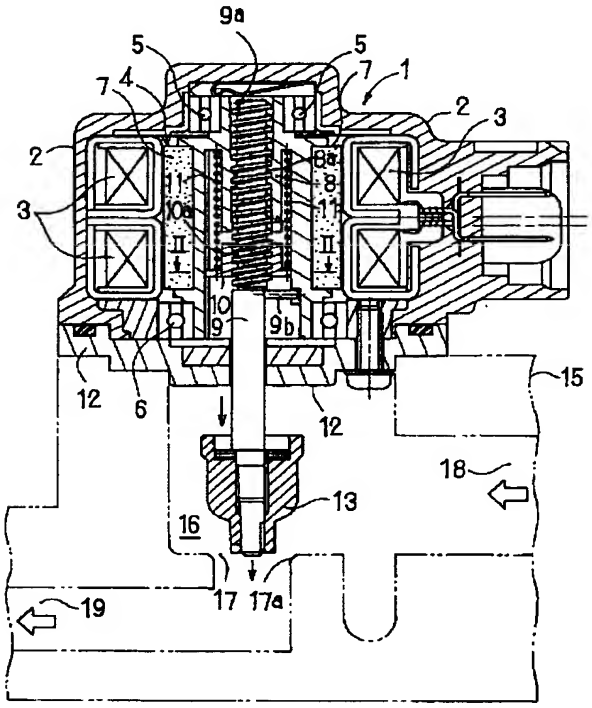
【図４】他の実施例のロータ内部の拡大断面図である。

【図５】従来のステップモータを使用した流量制御弁の縦断面図である。

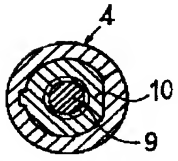
【符号の説明】

１－ステップモータ、４－ロータ、７－永久磁石、９－出力軸、１０－ばね受部材、１１－圧縮コイルばね。

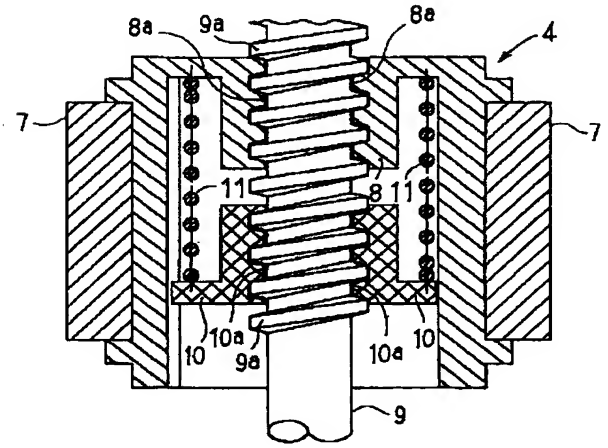
【図１】



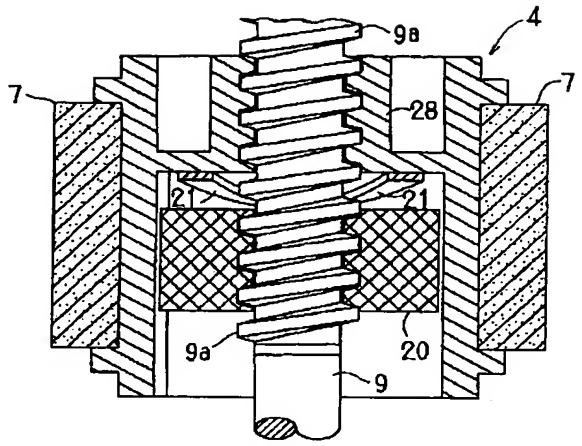
【図２】



【図３】



【図４】



【図５】